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Electric Machine Operation at Syowa Base

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越冬期間中の電気関係報告

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要旨

第3次越冬においては，(1) 1年無保守状態のまま放置された機器の回復と，(2) 空輸のため燃料節約を必要とし，(3) 多くの観測機械が設置されるため，電圧変動，三相発電機の相間バランス，各相の力率変動を極力防止する必要があった．そのため各部門の使用電力量，使用時間を規制し送電系統を並列に改めて負荷の調整を行なった結果，各棟約 5 KW の負荷時の入力端子間電圧降下は約 0.5 V 以内に改められた．20 KVA 発電機の燃費は上記の規制に隊員の協力を得て予想以上の節約ができた．運転時間は1号が 5479 時間，2 号は 3116 時間で非常に良好に保守され機器の故障は皆無，送電停止時間は計 11 分 30 秒，発電機関係の補用品も充分量保有している．発電量は年平均1日 134.2 KVA，燃費は 80.7 l であった．

小型発動発電機類も飛雪に対する注意と燃料内の氷晶除去に留意すれば低温下でも容易に運転できた．450W DC 発電機が雪上車の APU としても最も使用され，特に −40°C 以下の雪上車の起動に際しあらかじめ本機でバッテリーに 30A の充電電流を約5分間流すことにより，予熱の必要なく安全に一気に起動できた．その他フィールド用として 1 KVA, 350W AC 発電機も使用した．バッテリーは電解液の比重低下したものが液凍結によって破損したものがある．高比重 (1.35/−30°C 以上) に保つことが必要である．電気関係の諸機器は非常に良好な状態に保たれ，適切な保守によって相当長期間の使用に耐え得る．

1. 20 KVA AC generator

Total operation hours; No. 1 Gr. 5479 hours (forehalf of year)
No. 2 Gr. 3116 hours (rearhalf of year)
〃 term; 17. Jan. 1959 to 15. Jan. 1960. 9.00 a.m.

Generating Power and Fuel Spending

	Year average	Winter average	Summer average
Fuel spending/day	80.7 L	83.1 L	76.5 L
Generating power/day	134.2 KVA	159.8 KVA	111.9 KVA
Fuel spending/hour	3.38 L	3.46 L	3.18 L
Generating power/hour	5.59 KVA	6.69 KVA	4.66 KVA
Fuel spending/1 KVA	0.61 L	0.52 L	0.68 L

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Generating power for every section	Winter average (15, May to 15, Aug.)		Summer average (1, Dec. to 5, Jan.)	
Observation	51.0 KW	32.9 %	33.2 KW	29.7 %
Kitchen Cooking	38.9 KW	25.3 %	38.9 KW	34.8 %
Lighting	23.2 KW	15.0 %	13.1 KW	11.7 %
Room heating	15.0 KW	9.5 %	1.0 KW	0.9 %
Radio Communication	9.0 KW	6.0 %	9.0 KW	8.0 %
Others	8.7 KW	5.7 %	8.7 KW	7.8 %
Daily average of a week operation	8.0 KW	5.4 %	8.0 KW	7.1 %

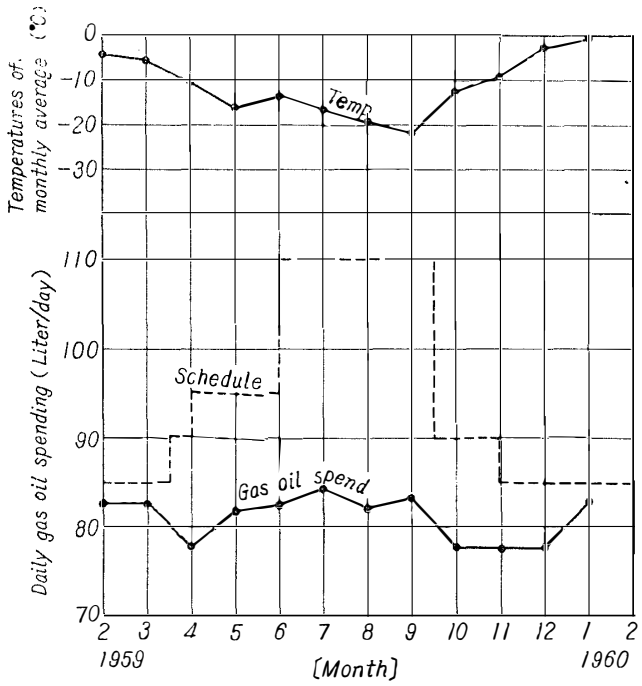

Fig. 1. The relations between the temperatures and daily gas oil spending for 20KVA generator.

Monthly fuel spending is shown in Fig. 1. There is a very interesting relations between the temperatures of monthly average and the daily fuel spending for the same month.

Total gas oil spending per year 157 cans 31,400 L

Gas oil spending for the generator 27,502 L

Overhaul; No. 1 Gr.-June. 17, 1959-to June. 25. 3000 hours overhaul

No. 2 Gr.-Jan. 16, 1960 3000 hours overhaul

The changing spare parts; Main roller bearing, brushes and cleaning of the surface of the commutator and slip rings.

Accidents ; None, but there were two breakdowns during the year with a total time of eleven minutes and thirty seconds. The first was caused by a blocked fuel pipe, and the second by water mixed with the fuel.

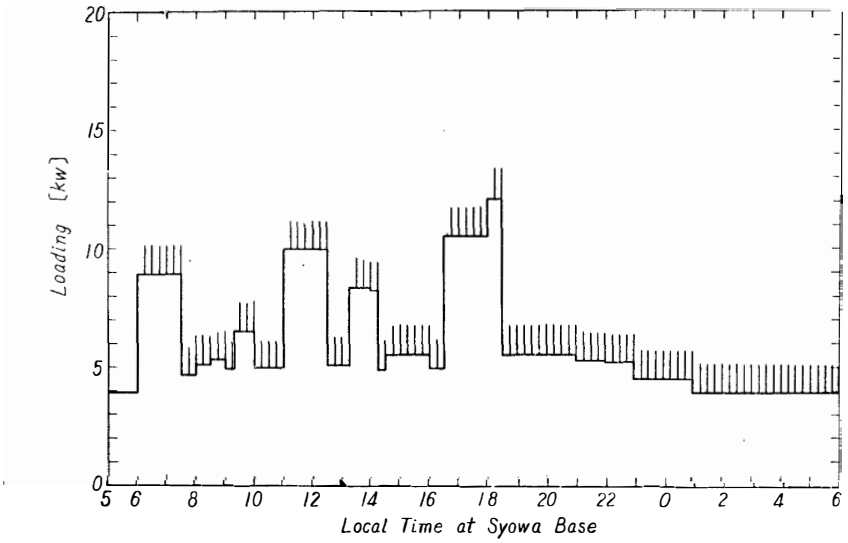

Fig. 2. The Electric Load Regulation Schedule for the 3rd winter parties at Syowa Base.

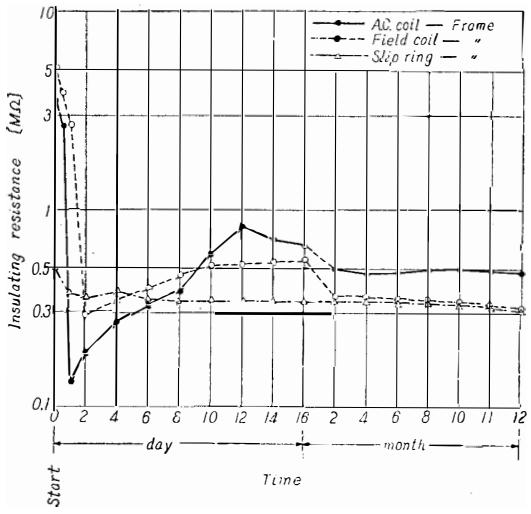

Fig. 3. The insulating resistance between coil and frame of the No. 1 Generator, when it started after one year stopping.

Present situation and some views; Both generators and AVR No. 1 and No. 2 are in good condition and should be used without accident for a long time in the future. Many spare parts are remaining and further supplies will be needless for the 5th wintering party.

Regulation of loading power and time served in prevention of overloading, balancing between 3 phases, improvement of fuel consumption and stabilization of load voltages. Fig. 2 is illustrated to the load regulation schedule for the third wintering party.

Fig. 3 shows the very interesting curves of the insulating resistance between coil and frame of the No. 1 generator, when the generator were started after one year stopping.

2. 20 KVA AC generators AVR

We used AVR (automatic voltage regulater) No. 1 by repairing the previous set, and used No. 2 which was transported with the third party then making use only of ampere-maters in a previously installed set. In all the period, voltage was regulated automatically and the ratio of voltage stabilization amounted to within one percent.

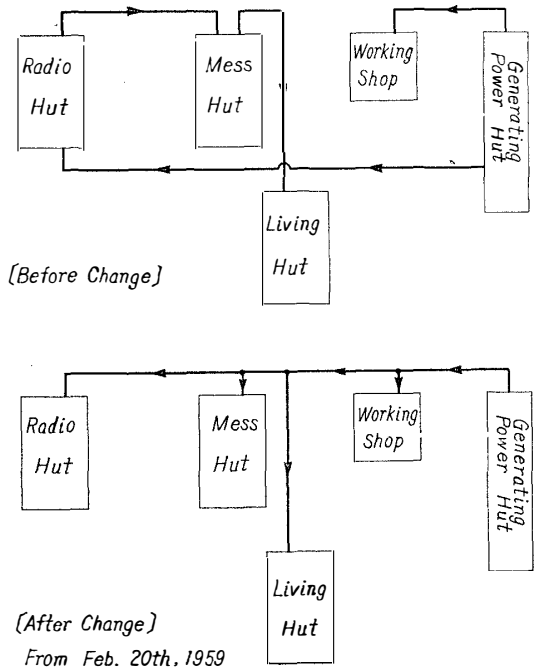

Fig. 4. The changing of wiring for 100V Trunk Bus System at Syowa Base.

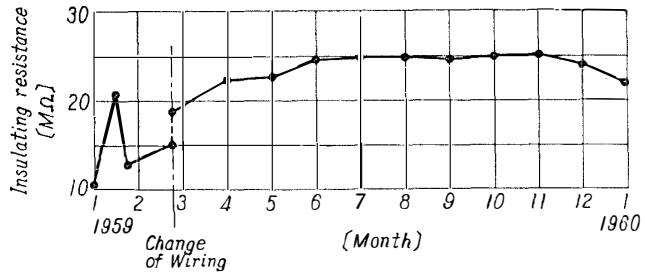

Fig. 5. The insulating resistance with every month of the wiring at Syowa Base.

3. Wiring

Previous system by which power is transmitted from a Generating Power Hut to a Radio Hut to a Mess Hut to a Living Hut in series was improved so as to transmit power to every hut in parallel as shown as Fig. 4, because measuring instruments were set in the Living Hut, a cooking range was arranged in the Mess Hut and we had a bad voltage stabilization and a large voltage drop. As a result we had 5 KW loads voltage variation less than 0.5 volt in every huts.

In order to prevent fire accidents examinations of all wiring and the measurements of insulating resistance were down every month and everything was all right over 30 MΩ throughout a year. Fig. 5 shows the insulating resistance with every month.

4. Small power engine drive electric generator

Three different types were used. These were indispensable to the trip. They were usable excellently at low temperatures, if the carburettor air-intake was prevented from drift snow and ice crystals in fuel were filtered up.

1) 1 KW AC Generator It was used for ice-bowling and was brought in every trip for the observation of depth of ice and sea by seismic system. It was easily used in spite of the extremely low temperature and could easily be started even at less than -40°C. It was perfectly well used when arranged in the caboose.

2) 450 W DC Generator It was indispensable for the trip as APU of snow cars and as a power source of some measuring instruments. It was well worked in low temperatures and could easily be started. Some spare parts should be supplied.

3) 350 W AC Generator It was used as a power source in emergency and as a small power source for the outdoor working. Voltage stabilization was good and easily usable. Some spare parts should be supplied.

5. Batteries

1) Four new batteries, transported by the third party (One of them, used for

a self-recording meteorological meter for long-term on the intraantarctic continental observation was abandoned).

2) Eight ones, transported by the first party and charged by the third (One of them uncharged). Their characteristics before discharge were irregular and the mean capacity was ca. 92% of that of 1).

3) Old ones charged by the first party. Some of them passed winter-term with lower specific gravity, and were broken by freezing, and the remaining twelve were found well charged. These 3) are mostly of no use. At such low temperature as -49°C they could start the snow car at one try when kept over-charged (Specific gravity more than 1.38/-30°C).

6. Charge

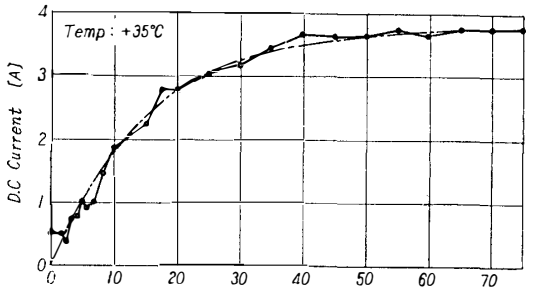

Fig. 6. One of the examples of aging characteristics for old selenium rectitiers [from Jan. 20th, 1959].

As for the selenium rectifier which had passed an uninhabited winter, the semiconducter characteristics was lost and its internal resistance grew too high to be recovered by aging. Fig. 6 shows this aging characteristics. So, only one charger (50V-10A), transported by the third party, was used.

7. Light and Room Heat

Fl. disch. tubes (40 W grow starter type), used by the first party, remained unusable except two of Generator Hut. That is, the lighters worked badly and inside of tube-walls near the heaters became sooty.

Furnaces were used only 3-4 hours a day for the Living Hut and Radio Hut in winter, being fairly helped by heat radiation from observation apparatuses. For the Mess Hut, 5 hours a day.

The gas oil expenditure amounted less than 200 L per month (all the year round).

8. Electrical tools and materials

Brittleness in low temperature of wirestrippers, pincers and nippers etc. was, conspicuous. Some of them are broken easily below -30°C. Soldering of wiring on the field work was very difficult but AMP terminal system was very suitable for that work. The material used for wiring was lacking in small parts like plugs and sockets. Storing captire cords are almost used up. Most useful insulating tape used for in low temperature are the crude rubber tapes.

9. Generally

Electric generator, AVR, Terminal board and busline were kept in very good condition, and were kept good for a fairly long time by suitable conservation. The temperature of the Power Hut was kept about +30°C on the floor and +40°C one meter above the floor, therefore, the oil and grease for machineries and tools in the Power Hut did not need protection from low temperature rating. Except for two months of summer season, dust was very rare, and loss of brushes and bearings was very small than in low latitude region.

On the small power engine drive electric generators for trip and field work, the carburetter air-inlet and the fuel circuit were not strong against drift snow. It was proven, that if set in a caboose or protected in some other way, the two cycle crank case inhalation type gasoline engine was easily started without pre-heating and kept in good condition in spite of the extremely low temperature less than −45°C.